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(54) A process and apparatus for the flotation of fibrous suspensions

(57) An injector is provided in each flotation cell via which the suspension is supplied in the vicinity of the base of each flotation cell. An upwards flow of the suspension occurs, during which flotation of the dirt particles takes place. In the vicinity of the base of each flotation cell some of the suspension is drawn off and is supplied again in the circuit to the injector of the flotation cell concerned. In this way the minimum average period of dwell for all the particles of each flotation cell is correspondingly longer and the overall flotation effect is correspondingly improved.

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Claims 6—8 were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982

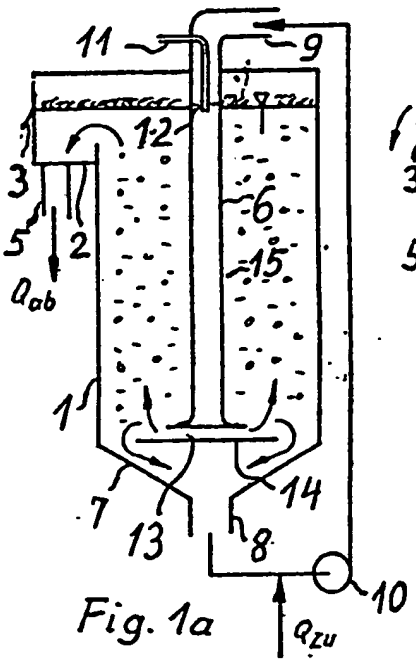

Fig. 1a

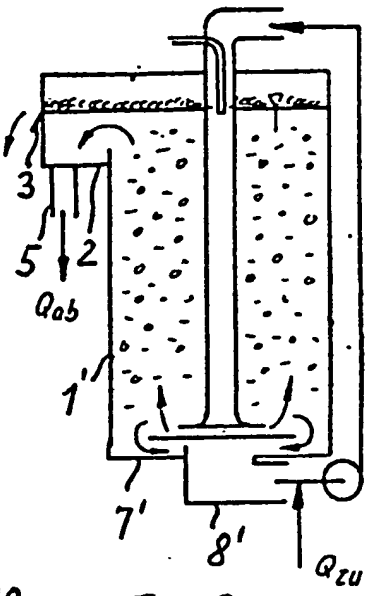

Fig. 2a

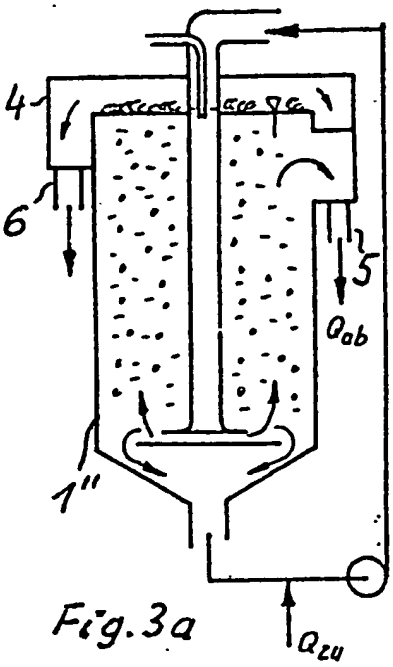

Fig. 3a

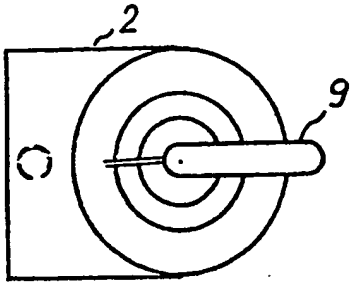

Fig. 1b

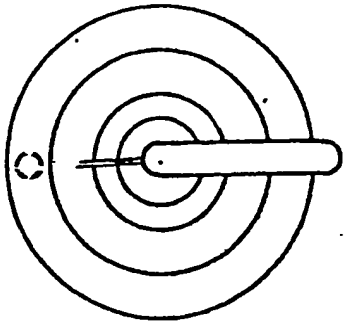

Fig. 3b

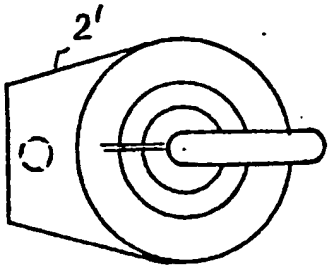

Fig. 2b

SPECIFICATION

A process and apparatus for the flotation of fibrous suspensions

The invention relates to a process for the flotation of fibrous suspensions in a flotation tank including the extraction of at least part of the suspension at least in the vicinity of the base of the flotation tank and re-introduction of part of the suspension already injected into the flotation tank again at least in the vicinity of the base of the flotation tank by means of at least one injector, and suitable and expedient apparatus for carrying out the process.

Apparatus for carrying out the above process is disclosed in DE-AS 29 14 392. With this apparatus the whole amount of the suspension is drawn off at the base of the flotation tank. The supply of both the fresh suspension, i.e. the suspension which has yet to be cleaned, as well as the suspension conducted round the circuit is effected via injectors which are arranged at intervals approximately radially around the circumference with a tangential outflow direction, but in separate systems. A great many injectors are required in this apparatus, and it is exceedingly complicated as a whole. The flow conditions in the flotation tank of this apparatus appear to be unfavourable, or at least not unequivocally favourable for separating out the particles of dirt. It would appear according to the statements in this specification that the functioning of the apparatus should be regarded as unsuccessful, since according to the functioning diagram contained therein, upwardly and downwardly flowing streams of suspension would have to cross over, which is inherently impossible.

The object of the invention is therefore to devise a flotation process which provides unequivocal conditions and occasions the greatest possible flotation effect, and to specify apparatus which enables this favourable effect to be achieved and still further improved, and which is also extremely simple in construction. This is important in view of the fact that the cost of such flotation plant, insofar as it is to be used for waste paper, must be kept especially low.

This object is achieved by the characteristic features in Patent Claim 1. Subsidiary Claims 2 to 4 indicate particularly expedient apparatus according to the invention.

By means of the invention the effect is also achieved that a relatively large throughput quantity flows through the injector so that a large amount of air is sucked in due to the correspondingly high flow speed, i.e. a specific amount of air can be carried in in an energy-saving manner, as the energy requirement of an injector increases quadratically proportionally to the air/liquid ratio.

In the following, the process according to the invention is described with reference to the apparatus developed for this purpose shown in the Figures which illustrate various embodiments of this apparatus, the Figures designated "b" showing the corresponding plan view of the embodiment concerned.

In the Figures, 1 or 1′ or 1″ designates the flotation tank into which a mixer pipe 15 projects. Between the injector outlet and the constriction point 12 this mixer pipe comprises a mixing section in which the suspension mixes with air bubbles. The injector outlet is formed by a radial diffusor 13 which bears a shut-off plate 14 extending substantially horizontally on the side facing the floor 7 or 7′ of the respective flotation tank. With this arrangement the flow out of the injector has a flow line which initially deviates only slightly from the horizontal. After this, the flow separates into a stream flowing upwards and a stream flowing downwards. The portion flowing downwards is selected so that the perpendicular component is less than the speed of ascent of the air bubbles, including also any bubbles on which particles of dirt might already have lodged.

A small air tube from which the necessary flotation air is sucked is inserted centrally in the constriction point 12 of the injector 6. It is possible to provide further small air tubes of this kind immediately below the constriction point in the pipe of the mixer section 15. The suspension supply line 9 is connected as a pressure-increasing pump 10 which provides the necessary level of pressure for the injector and the other pipe-line losses. The quantity of suspension flowing downwards arrives in the draining line 8 or 8′ respectively and then passes to the pressure-increasing pump 10 as well. Before this pressure-increasing pump the line for the new suspension to be fed in (indicated here by an arrow with Q_{zu}) combines with the branch line 8 for the suspension already conducted in the circuit.

Due to this arrangement a very favourable, extremely short period of dwell is obtained for all the particles, including the suspension, thus the water and the fibres, in the flotation tank. It can actually never be less than the mean period of dwell for all the particles which is obtained from the relationship V_z/Q_{zu}. In the equation V_z is the amount of suspension being supplied fresh to the flotation tank at any given time, thus as shown in the Figures. The flotation result is hereby very greatly improved since all the dirt particles are given the greatest possible opportunity of lodging on the small air bubbles. Furthermore, the apparatus according to the invention displays clear flow conditions which are also favourable for the flotation effect. Moreover, the removal of froth can be effected very simply. The quantity of suspension flowing upwards is in fact conducted at least to only slightly below the surface of the liquid and is drawn off there in an overflow. This means that there is a flow radially outwards which also carries the froth with it. Via a further overflow which is designated 3 in the Figures the froth can then be drawn off. The cleaned suspension is then conducted away, for example as shown in Figures 1a and 2a, via an extraction tank 2 and the pipeline 5 connected thereto. In the case of Figures 3a and 3b the cleansed suspension is

drawn off some way below the surface of the liquid and is conducted away via the pipeline 5, while the froth is drawn off via an overflow in a froth extraction channel 4 located right at the rim of the container, and passes through the froth pipeline 6.

It is now possible, by varying the various partial streams of suspension, to adjust their proportions according to requirements. In every instance a relatively long mean period of dwell in the flotation tank is obtained for the particles. In other words, considered statistically, by dividing up the periods of dwell of all the particles according to the Gaussian bell-shaped curve, a relatively small portion of suspension with particles with relatively short periods of dwell is obtained. In this way, a particularly favourable flotation effect is possible, which was not the case with the apparatus known hitherto.

CLAIMS

1. A process for the flotation of fibrous suspensions in a flotation tank, including the extraction of at least part of the suspension at least in the vicinity of the base of the flotation tank and re-introduction of part of the suspension already injected into the flotation tank again at least in the vicinity of the base of the flotation tank by means of at least one injector, characterised in that a relatively small amount of the suspension is drawn off at the base of the tank and supplied again to the injector or injectors of the same cell.

2. A process according to Claim 1, characterised in that after the injector outlet suspension flows both to the surface of the suspension as well as to the base of the flotation tank, the amount of suspension flowing away downwards and to be re-introduced being drawn off separately from the remainder of the suspension and selected so that the velocity of descent of the suspension is less than the velocity of ascent of the small air bubbles, including, where applicable, those bubbles already lodged against particles of dirt, the suspension flowing upwards reaching at least the vicinity of the surface of the liquid in the flotation tank.

3. Apparatus specifically adapted to carry out the process according to Claim 1 or 2, characterised in that there is only one injector which is equipped with a diffuser which causes the suspension to flow out horizontally and which is arranged itself at the end of a mixing section extending substantially perpendicular and arranged after a constriction point in the suspension supply line, that the branch line for the part of the suspension conducted in the circuit and the supply line for the suspension which has yet to be treated in the flotation tank are combined before the constriction point in the suspension supply line, and that the branch line leaves from the base of the flotation tank.

4. Apparatus according to Claim 3, characterised in that the branch line and the suspension supply line for fresh suspension are combined before the pressure-increasing pump for the injector.

5. Apparatus according to any one of Claims 3 or 4, characterised in that the flotation tank is constructed as an upright cylinder with its base constructed in the shape of a truncated cone tapering in a downwardly direction.

6. Apparatus according to any one of Claims 3 to 5, characterised in that the lower part of the radial diffusor is a substantially horizontal shut-off plate, which is located some way above the base of the flotation tank.

7. Apparatus according to one of Claims 3 to 6, characterised in that the outlet for the cleansed suspension is located in the uppermost part of the tank.

8. Process or apparatus for the flotation of fibrous suspensions in a flotation tank substantially as hereinbefore described with reference to the accompanying drawings.

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